Fenestrated endovascular aneurysm repair with concomitant horseshoe kidney

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ABSTRACT

Horseshoe kidney (HSK) is a rare anatomic anomaly that poses surgical challenges in the setting of abdominal aortic aneurysm repair. An endovascular approach is safer for patients yet carries technical challenge because of variable renal vasculature. We present the case of a patient with an infrarenal abdominal aortic aneurysm and concomitant HSK who underwent successful repair with a custom fenestrated endograft with preservation of a midaortic renal artery. Complex endovascular aneurysm repair options for HSK include chimneys and fenestrated stent grafts. We suggest that the availability of custom fenestrated grafts and ongoing skill enhancement among vascular surgeons may make this approach more favorable. (J Vasc Surg Cases and Innovative Techniques 2020;6:14-7.)

Keywords: Horseshoe kidney; Aneurysm; Fenestrated; Endovascular

Horseshoe kidney (HSK) is a rare anomaly with a prevalence of 0.25%.[1] It poses surgical challenges in the setting of abdominal aortic aneurysm (AAA) repair, and maintenance of perfusion to the HSK is paramount. The Eisendrath classification categorizes renal vasculature, of which 50% has aortic branches supplying the isthmus (Fig 1).[2,3] Open surgical approaches can be technically challenging as the isthmus often overlies the aneurysm.[4] A hostile abdomen can further complicate this approach. Endovascular approaches may be safer but carry unique technical challenges related to the renal artery arrangements. We present a case in which a custom fenestrated endograft was used to accommodate a large midaortic renal artery supplying the isthmus of the HSK in a patient with multiple previous abdominal operations. The patient provided consent for this case report and related imaging.

CASE REPORT

A 60-year-old man with a 5.3-cm AAA and HSK presented for elective repair. His surgical history included emergency exploration for self-inflicted gunshot wound with repair of traumatic diaphragmatic hernia and an elective ventral hernia repair with mesh. Renal function was normal. A renal perfusion scan was not performed preoperatively. Computed tomography angiography showed Eisendrath type III HSK with a large 6-mm renal artery arising from midaorta, supplying the isthmus, and two renal arteries for both sides of the HSK. A custom fenestrated stent graft was designed to accommodate the midaortic renal artery with a small fenestration to avoid sacrifice of parenchymal circulation (Figs 2 and 3). Adequate seal zones were available both above and below the midaortic artery, and therefore additional scallops or fenestrations for main renal arteries were not necessary.

The patient was sedated, and the operative site was prepared in usual sterile fashion. After percutaneous femoral access, a 20F sheath was passed and doubly accessed with 6F sheaths. The proximal main body device (Zenith fenestrated graft [ZFEN-P-2-32-94]; Cook Medical, Bloomington, Ind) was advanced into perivisceral aorta and fenestration aligned, then partially deployed. A long sheath was then placed in the midaortic renal artery. The main body was deployed, and fixation was achieved with a balloon (Fig 4). A 6- × 16-mm balloon-expandable covered stent (iCAST; Atrium Medical,

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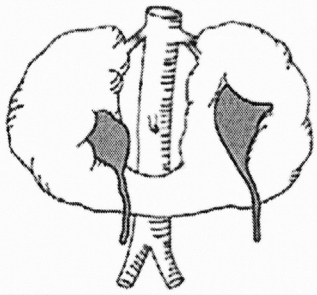
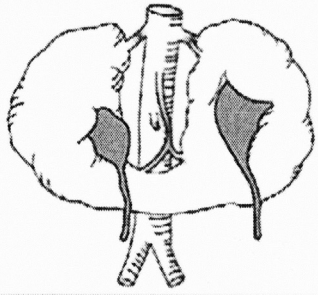
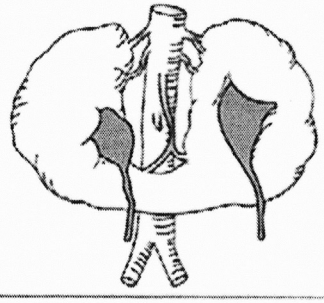
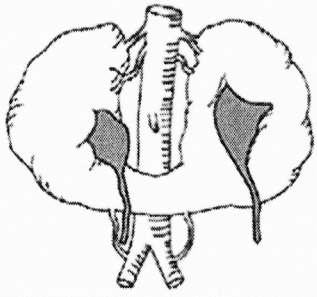
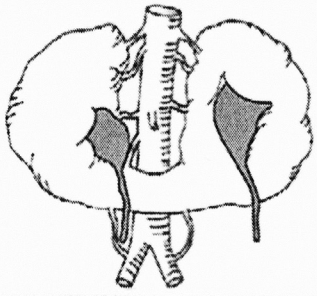
Type I	One renal artery for each side of the horseshoe kidney		20 %
Type II	One renal artery for each side with an aortic branch to the isthmus		30 %
Type III	Two arteries for each side and one renal isthmus artery		15 %
Type IV	Two arteries for each side with one or more arising from iliac arteries, including the isthmus branch		15 %
Type V	Multiple renal arteries originating from the aorta and mesenteric and iliac arteries.		20 %

Fig 1. Classification of horseshoe kidney (HSK) arterial patterns as derived from Eisendrath's original paper.[2,3] (From Ruppert VR, Umscheid T, Rieger J, Schmedt CG, Mussack T, Steckmeier B, et al. Endovascular aneurysm repair: treatment of choice for abdominal aortic aneurysm coincident with horseshoe kidney? Three case reports and review of the literature. J Vasc Surg 2004;40:367-70. Reproduced with permission of Elsevier.)

Fig 2. Computed tomography angiography axial view of midaortic artery supplying isthmus of horseshoe kidney (HSK).

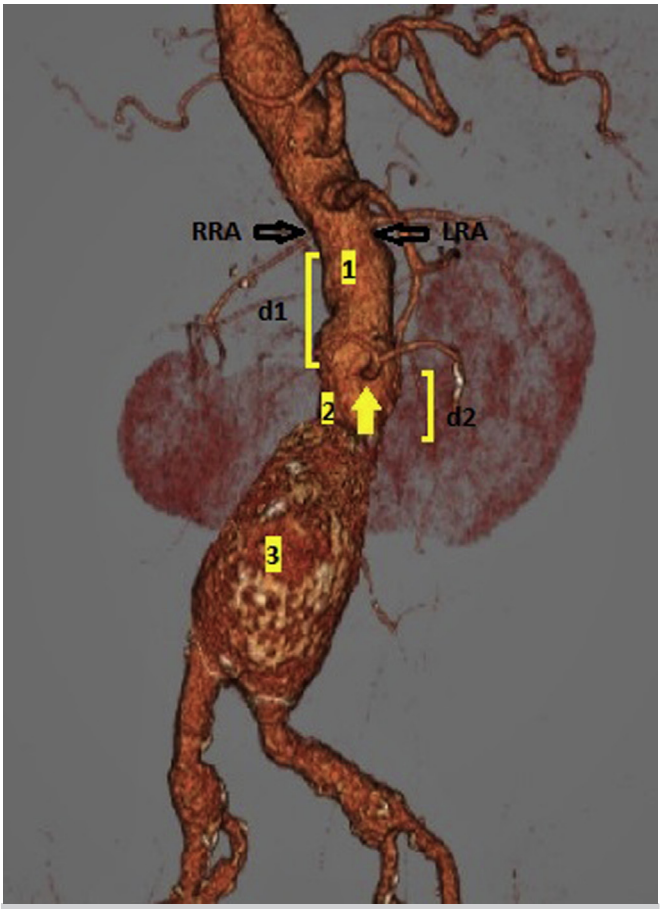


Fig 3. Preoperative computed tomography angiography three-dimensional reconstruction showing relationship of right renal artery (*RRA*), left renal artery (*LRA*), and midaortic renal artery (*arrow*). Centerline distance from lowest right renal artery to midaortic renal artery (*d1*) is 26 mm; distance from midaortic renal artery to proximal aneurysm sac (*d2*) is 23 mm. *1*, Aortic diameter range, 25 to 28 mm. *2*, Aortic diameter range, 29 to 30 mm. *3*, Maximum aortic diameter, 53 mm.

Merrimack, NH) was then deployed in the midaortic artery and "flared" open. The distal main body and limbs were then deployed in standard fashion. Completion imaging showed perfusion to the entire HSK with no obvious endoleak. The patient recovered well with normal renal function and was discharged. The most recent computed tomography angiography scan performed at 6 months showed a stable repair with preserved flow to the HSK, no endoleak, and decrease in sac size to 4.4 cm (Fig 5).

DISCUSSION

HSK has a prevalence of 0.25%, and open repair has historically been the preferred approach. The arterial patterns of HSK can create technical challenges, and preservation of renal arteries with diameters >3 mm supplying a significant percentage of the HSK was a general rule.[3] Nonfenestrated standard endografts were eventually used, sometimes with physician modifications, to repair AAA with HSK with attention to renal variation, usually with intentional coverage of insignificant renal vasculature <3 mm. With the advent of fenestrated endografts, options to repair aneurysms with preservation of perivisceral arteries using covered stents became available.[5,6] Preprocedural planning is paramount for custom fenestrated endografts to ensure accurate placement of fenestrations and good seal.[7] Other options for repair of AAA with HSK include hybrid operations with open surgical debranching of important renal arteries and then a staged endovascular aneurysm repair. Of course, the long-term durability of a fenestrated repair is still unknown, and HSK renal artery anatomy is so variable that tracking outcomes for these unique cases is important. We can anticipate from the current literature for standard fenestrated grafts that there may be an increased need for secondary interventions or potential for loss of seal due to ongoing degeneration of the aorta in untreated segments. There may be more difficulty in treating type IA endoleaks if they arise; however, availability of

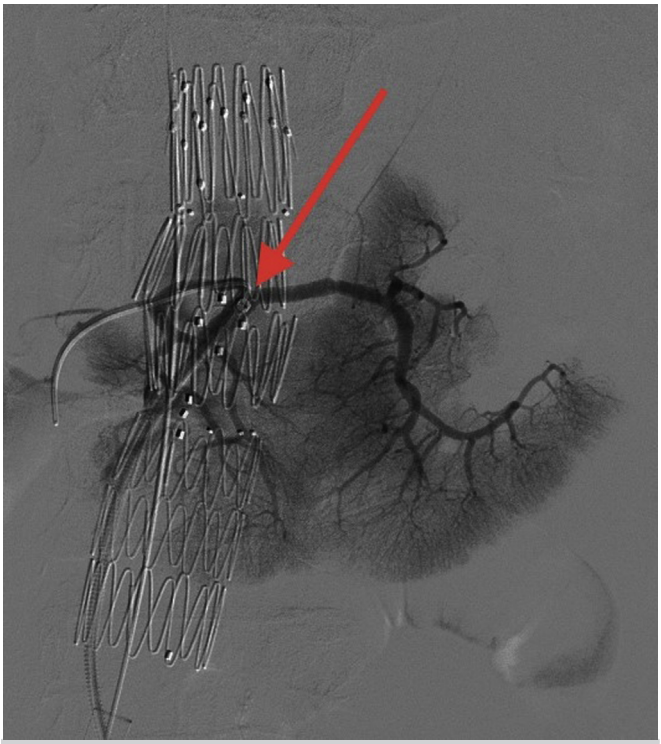


Fig 4. Selective renal angiogram through custom fenestration for type III horseshoe kidney (HSK) renal artery pattern.

Fig 5. Computed tomography angiography three-dimensional reconstruction 6 months postoperatively.

EndoAnchors (Medtronic, Santa Rosa, Calif) and future technologies may make this less of an issue.

CONCLUSIONS

AAAs with concomitant HSK prove difficult to treat with traditional open repair because of renal artery patterns. Endovascular repair is generally associated with lower morbidity than open repair. If the prerequisites of anatomic suitability and normal renal function are fulfilled, fenestrated endovascular aneurysm repair is an excellent option in the presence of AAA with concomitant HSK. Published data on this approach are limited to case studies, and further evaluation of long-term results is warranted.

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